1889MNRAS..49..292T

Scale attached to the Photograph of the Rotating Star.

Square No.	Seconds Exposure.	Readings.	Mean Reading.	Amount of direct light on Screen.	Adopted Reading.	Remarks.
1	3	67, 67, 67	67	⅛	536	For these readings a second set of rotating sectors was placed in front of the direct light to reduce it. The direct light was thereby made only ⅛ of the original light.
2	5	57, 56, 57	56·6	⅛	453	
3	10	32½, 33½, 33	33·0	⅛	264	
4	15	22, 23, 22	22·6	⅛	181	
5	20	14, 16, 15, 15	15·0	⅛	120	
6	30	8½, 9½, 9	9·0	⅛	72	
6	30	72, 71, 71	71·3	1		
7	45	47, 47, 47	47·0	1	47	
8	60	32, 33, 32½	32·5	1	32·5	
9	75	26, 25, 26	25·6	1	25·6	
10	90	23, 23½, 22½	23·0	1	23·0	
11	120	17, 17½, 18	17·5	1	17·5	

Note on the Law of Increase in Diameter of Star Discs on Stellar Photographs, with Duration of Exposure. By H. H. Turner, M.A., B.Sc.

In vol. xl. of the *Proc. Roy. Soc.*, p. 449, Professor Pritchard states that, according to his researches, the area of a star image varies nearly as the square root of the duration of exposure, or the diameter as the fourth root of the duration. He further remarks that Bond in 1858 considered the diameter to vary as the square root of the duration. It is therefore, perhaps, worthy of notice that, in some photographs taken at Greenwich with a Dallmeyer object-glass of 4 inches aperture and 5-foot focus, the diameter of the images seems to vary nearly as the cube root of the duration of exposure through a considerable range—a result intermediate between those of Bond and Pritchard. The following measures of the diameters of star-discs on different plates illustrate this point. The diameters are divided by the square roots, the cube roots, and the fourth roots of the durations, to exhibit the relative merits of the three hypotheses in question. It will be seen that the numbers in the cube-root column are generally nearly constant, while those in the other two decrease or increase. The numbers attached to the plates are merely those of the Greenwich series, for convenience of reference.

Plate 18. Region near α *Aquilæ.* 1887, August 31. Four exposures of 1^{m}, 5^{m}, 10^{m}, and 20^{m}, at the corners of a square.

1889MNRAS..49..292T

Three bright stars. (Mean of magnitudes about 3.)

Duration of Exposure $=t$.	Mean Diameter of Discs $=D$.	$\frac{D}{t^{\frac{1}{2}}}$	$\frac{D}{t^{\frac{1}{3}}}$	$\frac{D}{t^{\frac{1}{4}}}$
m	″	″	″	″
1	23·0	23·0	23·0	23·0
5	38·3	17·1	22·4	25·5
10	50·5	16·0	23·5	28·4
20	64·0	14·3	23·6	30·3

Four medium stars. (Mean of magnitudes about 6.)

1	5·4	5·4	5·4	5·4
5	8·4	3·8	4·9	5·6
10	13·0	4·1	6·1	7·3
20	15·7	3·5	5·8	7·4

Six faint stars. (Mean magnitude 7 or 8.)

The short exposure not registered.

1	—	—	—	—
5	6·8	3·1	4·0	4·5
10	9·2	2·9	4·3	5·2
20	13·2	3·0	4·9	6·3

Plate 22. Region near γ *Piscium.* 1887, October 22. Four exposures of 1^{m}, 5^{m}, 10^{m}, 20^{m}, at corners of a square. "Sky tolerably good."

Five stars. (Mean magnitude about 4½.)

Duration of Exposure $=t$.	Mean Diameter of Discs $=D$.	$\frac{D}{t^{\frac{1}{2}}}$	$\frac{D}{t^{\frac{1}{3}}}$	$\frac{D}{t^{\frac{1}{4}}}$
m	″	″	″	″
1	8·1	8·1	8·1	8·1
5	12·7	5·7	7·4	8·5
10	15·8	5·0	7·4	8·9
20	18·6	4·2	6·9	8·8

Plate No. 23. *Pleiades.* 1887, October 14. Three exposures of 2^{m}, 4^{m}, 15^{m}. "Sky very clear."

Five stars. (Mean magnitude about 4.)

Duration of Exposure $=t$.	Mean Diameter of Discs $=D$.	$\frac{D}{t^{\frac{1}{2}}}$	$\frac{D}{t^{\frac{1}{3}}}$	$\frac{D}{t^{\frac{1}{4}}}$
m	″	″	″	″
2	23·2	16·5	18·4	19·5
4	29·4	14·7	18·5	20·9
15	42·4	11·0	17·2	21·5

Five stars. (Mean magnitude about 6.)

2	8·9	6·3	7·1	7·5
4	10·8	5·4	6·8	7·7
15	18·9	4·9	7·7	9·6

1889MNRAS..49..292T

Plate No. 87. Region near R.A. $19^h\ 14^m$, Dec. + 20°. 1888, September 19. Exposures, 1^m, 2^m, 3^m, 5^m.

Seven stars. (Mean magnitude about 6.)

Duration of Exposure $=t$.	Mean Diameter of Discs $=$D.	$\frac{D}{t^{\frac{1}{2}}}$	$\frac{D}{t^{\frac{1}{3}}}$	$\frac{D}{t^{\frac{1}{4}}}$
m	″	″	″	″
1	7·6	7·6	7·6	7·6
2	9·2	6·5	7·3	7·7
3	10·8	6·2	7·5	8·2
5	12·2	5·5	7·1	8·1

In the above plates no particular attention was paid to the exact duration of exposure, which may thus be slightly inaccurate, especially in the case of short exposures; and the range of duration does not extend below 1^m. On 1889, March 6, special photographs of *Procyon* were taken, with exposures varying from 5^s to 20^m; but there was much haze in the sky, and often cloud, which interfered with the work. On the first plate exposures of 5^s, 10^s, 15^s, 30^s, and 60^s were secured before clouds came up; and, as it was not possible to resume operations for some time, a second plate was put in. On this exposures of 20^m, 5^s, 10^m, and 15^s were given in this order, before the work was quite stopped by clouds. On development, the exposure of 5^s on this plate was found to have been accidentally distributed into two of nearly equal size. It has been assumed that each of these was roughly $2\frac{1}{2}^s$, though some time must have been lost in transition, and allowance must be made accordingly. The following are the results of four independent measures, by each of two observers, of the various discs of *Procyon* on these two plates:—

First Plate.

Duration of Exposure $=t$.	Mean Diameter of Discs $=$D.	$\frac{D}{t^{\frac{1}{2}}}$	$\frac{D}{t^{\frac{1}{3}}}$	$\frac{D}{t^{\frac{1}{4}}}$
m	″	″	″	″
0·083	18·6	64·4	42·6	34·6
·167	23·5	57·6	42·7	36·8
·250	29·3	58·6	46·6	41·5
·5	33·6	47·5	42·4	40·0
1·0	40·8	40·8	40·8	40·8

The 15^s exposure is very irregular in shape, and obviously anomalous.

Second Plate.

Duration of Exposure $=t$.	Mean Diameter of Discs $=$D.	$\frac{D}{t^{\frac{1}{2}}}$	$\frac{D}{t^{\frac{1}{3}}}$	$\frac{D}{t^{\frac{1}{4}}}$
m	″	″	′	″
0·042	9·9	48·3	28·5	22·0
·042	10·8	52·7	30·9	24·0
·25	20·7	41·4	32·9	29·3
10·0	59·1	18·7	27·5	33·2
20·0	63·5	14·2	23·4	30·1

1889MNRAS..49..292T

It thus appears that for large star discs the increase of diameter does not increase quite so rapidly as the cube root of the duration, and tends towards the fourth root. For faint stars, on the other hand (as in the third set of plate 18), the rapidity surpasses the cube root, and tends to the square root. This suggests how both Bond's and Pritchard's results may be true under different circumstances.

Photographic Analyses of the Great Nebula M 42 *and* 43 *and* [*h* 1180 *in Orion.* By Isaac Roberts.

By the term photographic analyses is to be understood the appearances which this nebula presents with exposures of the negatives varying between 5 seconds of time and 205 minutes, and when the details are studied by aid of the gradations of the nebulosity which have been obtained in this manner we are enabled to compare the relative actinic power of the light in different parts of the nebula.

We are not to infer that any given exposure of a plate for, say, 15 minutes, or for any other number of minutes, represents a constant quantity of photographic effect which is always available for accurate comparison with other exposures during corresponding intervals of time, for it is found that the photographic effect generally varies from moment to moment during any exposure of a plate owing to atmospheric absorption or extinction of the light; but by taking a number of photographs and selecting them so as to exhibit small gradations in the density of the nebulosity, we see more of the structure than we probably can by any other method, and this applies with greater force to enlargements than to the original negatives.

In the illustrations now presented,* gradations are shown on seven enlarged photographic plates with eleven exposures of the negatives. The enlargements are to five times the size of the negatives.

PLATE 1.

The negative of which this plate is an enlargement was taken on February 16, 1889, and has upon it five consecutive exposures of 5 seconds, 30 seconds, 1 minute, 3 minutes, and 6 minutes respectively, and they show such of the stars and so much of the nebulosity as on that occasion were imprinted on the film. The four stars which form the trapezium are shown on the first exposure of 5 seconds, and they increase in diameter and in density till in the fifth exposure of 6 minutes they form one image with an irregular outline. The nebulosity begins to appear round θ in the third exposure of 1 minute, and in the 6 minutes' exposure it is well developed and characteristic. It will

---

* The photographs are placed in the Library.